ORIGIN OF THE PLANE-TREES.

BY LESTER F. WARD.

THE fourth number of Volume XI. of Engler's *Botanische Jahrbücher* contains an elaborate article by Johann Jankó, entitled "Abstammung der Platanen." The writer treats the subject in the characteristic German fashion, approaching it in an exhaustive manner from every possible point of view; and his contribution throws much light upon this interesting type of plant life. He had thoroughly prepared himself by careful observations continued during a number of years, and by collections, made at different and critical seasons of the year, from all the species of Platanus growing wild or in cultivation in Europe. He had also carefully studied the fossil forms, apparently only from the published figures, and evinces a wide acquaintance with these as well. He makes a searching revision of the species, both living and fossil, reducing the former to three, with numerous varieties, and the latter to eight.

The object of the paper, as indicated by its title, is to derive the living species from the fossil ones, and to show the line of descent of the former. The title is, nevertheless, misleading, since it would imply that the author was seeking the origin of the genus itself. So far is he from this that he rules out of the genus all the archaic forms occurring in the earlier formations, including *P. nobilis* of Newberry, and gives no intimation as to whether he regards them as ancestors of Platanus.

The following is his disposition of the fossil species:

With *P. aceroides* (Göpp.) Heer, he unites: *P. aceroides cuneifolia* Gaudin, *P. cuneifolia* Göpp., *P. ettingshauseni* Mass., *P. gracilis* Ett., *P. grandifolia* Ung., *P. œynhauseniana* Göpp., *P. pannonica* Ett., *P. rugosa* Göpp., *P. sterculiæfolia* Ett., *Acer ficifolium* (Viv.) Brongn., *A. heerii* Mass., *A. heerii deperditum* Mass., *A. heerii ficifolium* Mass., *A. heerii productum* Mass., *Acer heerii tricuspidatum* Mass., *A. heerii trilobatum* Mass., *A.*

productum Al. Braun., *A. pseudocreticum* Ett., *A. tricuspidatum* Al. Braun, *A. tricuspidatum subintegerrimum* Al. Braun., *A. trilobatum* (Sternb.) Al. Braun., *A. trilobatum genuinum* Engelh., *A. trilobatum patens* Al. Braun., *A. trilobatum productum* Al. Braun., *A. trilobatum tricuspidatum* Al. Braun., *Acerites deperditum* Mass., *A. ficifolius* Viv., *A. incerta* Mass., *Cissus platanifolia* Ett. *Quercus platanoides* Göpp., *Q. rotunda* Göpp.

He regards *Platanus academiæ* Gaud., *P. dissecta* Lx., and *P. appendiculata* Lx. as varieties of *P. aceroides* Göpp., the last two as identical.

To *P. gulielmæ* Göpp. he refers *P. aceroides* var. Heer, from Greenland.

He recognizes *P. marginata* (Lx.) Heer, the *Viburnum marginatum* of Lesquereux's earlier works, as a true Platanus.

He considers *P. heerii* Lx. a variety of *P. primæva* Lx.

He excludes from the genus Platanus the following: *P. affinis* Lx., *P. digitata* Ung., *P. diminutiva* Lx., *P. dubia* Lx., *P. hercules* Ung., *P. jatrophæfolia* Ung., *P. latiloba* Newb., *P. nobilis* Newb., *P. obtusiloba* Lx., *P. recurvata* Lx., *P. sirii* Ung.

A number of these have been, of course, long ago abandoned; but of the American forms, *P. diminutiva*, *P. nobilis*, *P. obtusiloba*, and *P. recurvata* had not been hitherto challenged.

He ignores the following species: *P. antiqua* Watelet, *P. aspera* Newberry, *P. basilobata* Ward, *P. borealis* Caspary, *P. dubia* Watelet, *P. heterophylla* Newberry, *P. klebsii* Caspary, *P. papilloni* Watelet, *P. subintegra* Göpp.

Watelet's species were so imperfectly figured and characterized that little could be said of them, and he was perhaps justified in passing them by unnoticed. Still less was he called upon to take account of those of Caspary and Newberry, and the last one on the above list, none of which have, to my knowledge, ever been figured. He was entirely unacquainted with the works of the present writer in which *P. basilobata* has been made known, viz., the "Synopsis of the Flora of the Laramie Group," "Types of the Laramie Flora," and "Paleontological History of the Genus Platanus." The last-named paper was sent to him as soon as his address could be found, and he has acknowledged it, and sent in

return a reprint of his paper, together with other works of his. In his letter of acknowledgment he expresses a deep interest in the subject of basilar lobes, but does not say whether he accepts my interpretation of their significance. *P. basilobata*, as I have pointed out, is so closely related in other respects to *P. nobilis*, that but for this feature I should have included it in that species; and Sir William Dawson, who had already figured it from the Canadian Laramie as *P. nobilis*, has, in his Geological History of Plants, proposed to call it *P. nobilis* var. *basilobata*. Prof. Jankó would therefore naturally have affixed to this species, as to *P. nobilis*, his sweeping verdict, "non est Platanus."

But the question, as it seems to me, is not so much whether these aberrant forms really belong to the present genus Platanus, as strictly limited by the characters presented by the few surviving species of that ancient type, as whether they represent the ancestors of these modern forms. The genus Platanus, like its close relative Liquidambar, like the monotypic Liriodendron, and like those holding-over forms of coniferous trees, the Sequoia and the Ginkgo, presents all the indications of being the last of a long lineage, and paleobotany, in this as in the other cases named, shows that it was once far more abundant than at present. So prominent a group must have had an ancestry, and the archaic forms found in the American Cretaceous deposits bear evidence of constituting that ancestry.

One of the distinctive links in this chain of evidence proves to be the presence of basal lobes. Nearly effaced in the latest living type, *P. orientalis*, this feature, nevertheless, sometimes occurs there, and was actually found by the searching observation of Professor Jankó, who, without the slightest suspicion of its significance, but true to his instincts of describing everything he found, described it in the following language: "Den Blattgrund betreffend, fand ich bei *P. orientalis* einen sehr interessanten Fall, dessen ganze Entwickelung ich beobachten konnte und welcher als Uebergangsform von der lappigen in die schildförmige betrachtet werden kann. Bei jenen Blättern nämlich, wo der Ausgangspunkt der drei oder fünf Hauptnerven nicht an der Grenze von Stiel und Spreite ist, vergrössert sich nicht selten der letzte Zahn,

mit welchem der Blattrand den Stiel berührt, und streckt sich mehr vor als die übrigen Zähne des Blattgrundes. An den inneren Rändern dieses Zahnes entsteht mit der weiteren Entwickelung ein zweiter Zahn, und beide erscheinen schon als kleine selbständige Lappen; wenn nun deren Grösse so lange wächst, bis diese zwei kleinen Seitenläppchen an einem Punkte sich berühren, so beginnt das Wachstum von diesem Punkte aus nach unten, und dieser Teil der Lamina ist nicht mehr an den Stiel gewachsen, sondern sondert sich von ihm ab. Dieses Läppchen ist manchmal ziemlich gross und kann im Allgemeinen als Resultat einer progressiven Entwickelung betrachtet werden."

I have never found it in that species as introduced into our American parks, where care is taken to trim out the sprouts and low branches on which it would occur, if at all. Fig. 1 represents a typical leaf of that species. But in the American form *P. occidentalis* in its wild state, especially on those abundantly nourished shoots of the season that spring from the base of stumps where the trees have been felled, I have for years observed it in all its phases, and studied its many curious transitions. These I have described, and have figured some of them in the papers mentioned, to which I would respectfully refer the reader.

In the original paper which I read before the Biological Society of Washington on February 20, 1886, I exhibited some forms that better illustrate the phenomenon than any that have been published. One of these I had figured, and sent the drawing, together with others and the paper itself, to one of the editors of the AMERICAN NATURALIST, at his request, for publication in that journal; but unfortunately it did not appear, owing to a change that took place in the publishers of the NATURALIST just at that time, in the course of which my manuscript was mislaid and could not be found. It has recently come to light and been returned to me, and I am able to introduce here (Fig. 2) the figure in question.

In view of the importance of the basilar expansions above mentioned, and of the fact that Professor Jankó excludes such forms as *P. nobilis* from the genus Platanus, I may perhaps be permitted, at the risk of some repetition of what has been said in my previous

paper, to introduce here that part of my original paper relating to these forms, inasmuch as I there dwelt upon them considerably more at length.

"Few as are the living representatives of this genus, it is now known that the type played an important rôle in later geologic time. More than twenty fossil species have been described, the greater part of which are from North American or Arctic strata. The American forms mostly occur in what is called the Laramie group, which all agree to place very near the boundary line between the Cretaceous and the Tertiary formations. The European, Arctic, and many of our western forms agree well enough with living species to leave no room for doubt as to their generic affinities, but in the Laramie group there occur some aberrant forms which have led to serious difficulties. The most notable of these is the *Platanus nobilis* of Newberry, from the Fort Union deposits. Our knowledge of this species is as yet confined to what we have been able to derive from the study of a large number of very fine leaf impressions. The leaves differ in some important respects from those of any living species of Platanus. They are usually very large, often measuring over a foot in length and width, and instead of having numerous short pointed lobes with broad sinuses, they have only three, or at most five, lobes, which are large and separated by acute sinuses, the margins being entire, or only slightly undulate-toothed. These characters give them much the aspect of many species of Aralia, and they possess other points of resemblance to that genus. They also have the general form of the three-lobed leaves of sassafras. Among the numerous specimens of this type collected by me on the Lower Yellowstone, in 1883, there is great variety in size, coupled with marked uniformity of shape and nervation. The smaller specimens agree in all essential respects with the *Aralia notata* of Lesquereux (Tertiary Flora, p. 237, Pl. XXXIX., Figs. 2-4), from Colorado and Wyoming, which he first called *Platanus dubia* (Hayden's Annual Report, 1873, p. 406) [Fig. 1 of my former paper (Proc. Nat. Mus., Vol. XI., 1888, Pl. XVII.)].

"In immediate association with *Platanus nobilis*, and perhaps merely as a state of it, there occurred a form differing chiefly in

the possession of a very remarkable appendage at the base of the blade. This appendage seems to constitute a miniature reflex of the leaf itself, projected backward over the petiole as a lobate expansion. It is palmately nerved like the principal blade, the primary nerves entering the lobes. These sometimes differ in number from those of the leaf, amounting to six in two of my specimens. They also vary considerably in length and shape. [See Figs. 2-5 of the paper last cited.]

"This basilar appendage is extremely interesting. It is not stipular, since it arises from the summit of a petiole of considerable length, six centimetres of it being preserved in one specimen without showing the attachment. Neither is it bracteal, and there seems no way but to regard it as a veritable part of the main blade, to which it is joined by a broad neck of parenchymatous tissue.

"There is good reason to regard this character as an argument in favor of referring these leaves to Platanus rather than to Aralia or any other genus. The leaves of Platanus have a tendency to produce appendages of various kinds. A good illustration of this is seen in the interesting *P. appendiculata* Lx., from the auriferous gravels of the Sierra Nevadas [Fig. 8 of that paper], where the generic affinities are not at all in doubt. But here the appendages appear to be stipular, though large and quite near to the base of the limb. In the sycamore of this country the stipules are prominent, and often lobed and nerved much like these appendages. They also often appear at the base of young branches bearing several leaves which are likewise provided with true stipules of the same form. In addition to this, however, there sometimes occurs a true basilar lobe or wing-like expansion on the leaf itself, which in the more marked examples very closely resembles those of the fossil impressions described. [Fig. 2 of the present paper represents such a case, and also shows the stipules as they are often produced.] Long before I had seen the fossil leaves I had remarked this tendency in *P. occidentalis* to develop such basilar appendages, and I had collected and preserved specimens of the leaves that bore them to illustrate this peculiarity.

"A careful study of these expansions leaves no doubt of their strict homology with those so much more prominently shown in the extinct form, and the conclusion is at least natural that they are the surviving vestiges of a once prevalent organ.

"Assuming the fossil form to be distinct from *P. nobilis*, which is, however, by no means certain, I have ventured to name it from the peculiar character above described, and to call it *P. basilobata*."

The close relationship of *P. basilobata* to *P. nobilis* renders it obvious that the two must stand or fall together as representatives or ancestors of the genus Platanus. Moreover, it would seem that if they are to be excluded the whole series of ancient types to which they belong, must be removed from the ancestral line of descent of the surviving forms. It appears, therefore, to be essential to the argument that the question whether they belong to this line be settled at the outset. We will, therefore, consider Professor Jankó's objections to the platanoid nature of *P. nobilis*. These are, first, that "It has five thick primary nerves (in a geological period in which this character is wanting in all), and from these very many (16-18) strong secondaries proceed parallel to one another without ending in teeth, their ends, however, reaching the margin of the blade; moreover, these secondaries are well developed to the base of the primaries, which does not occur in the corresponding forms of Platanus." In the second place, "The leaf is five-lobed at the beginning of a geological period in which this form does not occur in the planes; moreover, the lobes are very well developed and large, the depth of the sinuses is of the third degree, although this depth does not appear until the end of the Miocene, and is not characteristic even in the Pliocene." Finally, he objects that "The margin of the leaf of *P. nobilis* is undulating and not toothed; whereas, in the planes in which the nervation is developed as it is in that species, either teeth appear, or the margin is entire, in which latter case the secondaries converge over one another."

In reading these statements one naturally wonders from what source Professor Jankó has derived his knowledge of this species. The chief objection seems to be that the leaves are five-lobed,

with three lateral primaries. This is not at all the case. The original figure of Dr. Newberry (Illustrations of Cretaceous and Tertiary Plants, Pl. XVII.) shows at most only four lobes, and one of these is produced by an abnormally strengthened secondary arising out of one of the lateral primaries. In Dr. Newberry's description (Later Extinct Floras of North America, Ann. Lyc. Nat. Hist., Vol. IX., p. 67) he says: "Leaves . . . three-lobed, or sub-five-lobed, . . . two basilar nerves of nearly equal length and strength," etc.; and speaking of the secondaries arising from the lateral primaries: "The second or third one on each side is often much the strongest of the series, and is then prolonged into a small but distinct lateral, triangular, acute lobe, giving the leaf a somewhat pentagonal form." He figured only one of the leaves in his collection in which, as above stated, this strong secondary and supplementary lobe occur only on one side. From his description it is inferred that although this sometimes may occur on both sides, it is more frequently wanting entirely, and the leaves are simply three-lobed. They never have more than three primary nerves.

The large specimen figured by me (Types of the Laramie Flora, Pl. XVI.) is of this latter form, and the greater number of my specimens, and of all those seen by me (amounting to hundreds), belong to this class. It is, therefore, safe to say that *P. nobilis* has essentially a palmately three-lobed leaf with two lateral primaries.

So much for the general form. Next, with regard to the margins and the disposition of the secondaries. It is true that in Dr. Newberry's figure (the specimen I have not seen) the secondaries pass directly to the margin, and each one enters a very short, broad, and obtuse tooth, giving the margin an undulate rather than a dentate character. But this undoubtedly varies in different specimens, for he describes the secondaries as "terminating in the teeth of the margin." In my specimens there is the greatest diversity in the margins and in the behavior of the secondaries on approaching them. In the one figured in the "Types," these do not generally differ from Dr. Newberry's, although the secondaries are not all straight or parallel. But I

have other specimens, which will be published in my "Monograph of the Flora of the Laramie Group," in which there are all the variations from a sharply toothed margin with the secondaries entering the teeth, to an entire margin with the ends of the secondaries curving and arching over one another (camptodrome). Moreover, these differences sometimes occur in different parts of the same leaf. In my *P. basilobata*, so far as now known, the nervation is always camptodrome, and the leaves strictly three-lobed.

It may be well to point out in this place more specially than I have done hitherto that the characters last considered not only bear directly upon the ancient forms of the Cretaceous referred to Sassafras or Araliopsis, but also connect themselves with some of the living species, thus strengthening the argument that *P. nobilis* and *P. basilobata* form a sort of connecting link between these. Leaves of *P. racemosa*, for example, sometimes have very much the same form and general nervation of *P. nobilis*. Fig. 3 represents such a leaf now in the National Herbarium, even showing the one strengthened secondary producing a lobe similar to that of Dr. Newberry's figure. Otherwise it is true that the secondary nerves are different, but they are approached in some forms of *P. basilobata*.

On the other hand, there is much variation in these respects among the Cretaceous forms referred by Lesquereux and Newberry to Sassafras. The margins of the lobes are generally entire, as in the leaf which I reproduced from the Cretaceous Flora (Pl. XII., Fig. 2, of the former paper); but there are others, as, for example, that shown in Fig. 4 of the present paper, reproduced from Pl. XI., Fig. 1, of the same work, in which several of the outer secondaries terminate in teeth precisely as they do in *P. nobilis*.

It remains to consider Professor Jankó's argument from the geological history and distribution of the fossil species. This is the weakest part of his paper, as the ancient forms are so largely American, and American geology is so little understood in Europe. So far as fossil plants are concerned, it is chiefly known to Europeans through the works of Lesquereux, who never pre-

tended to be a geologist, and was led by the resemblance in the fossil floras, without taking account of other kinds of evidence, to place most American plant-bearing deposits too high in the series. Why, for example, should Europeans continue to follow Lesquereux in calling the Laramie group Tertiary, when King, Hague, Emmons, Powell, Cope, Marsh, and almost everybody else, have always called it Cretaceous? Moreover, I have shown in my "Synopsis of the Flora of the Laramie Group," published in the Sixth Annual Report of the U. S. Geological Survey, that the evidence of the fossil plants does not necessarily conflict with the latter view, and that the idea that it does so conflict arises from two causes: First, lack of attention to the character of the Upper Cretaceous floras already known; and secondly, the all embracing predominance of the Miocene flora of Europe, in which it is possible to find surviving types of the Cretaceous flora, and, indeed, almost anything that it is desired to find.

Again, Professor Jankó does not seem to be aware that most or all of the Tertiary plant-bearing deposits of the Arctic and sub-Arctic regions which Heer classed as Miocene are regarded as Eocene by those who are now chiefly devoted to their study. Heer's fallacy was also two-fold. Not only was he led astray by the abundance of the Miocene flora to which, as developed in Switzerland, he had devoted so much of his life, but he also failed to make sufficient allowance for the effect of high latitude in causing a flora to appear more recent than it is, as has been chiefly pointed out by Gardner.

The geological distribution of the fossil species according to Jankó, employing his own nomenclature with its exclusions, is as follows:

Cretaceous.—*P. primæva, primæva heerii,* and *newberryana.*

Eocene.—*P. rhomboidea, raynoldsii, haydenii,* and *gulielmæ.*

Miocene and Pliocene.—*P. aceroides, aceroides academiæ, aceroides dissecta, gulielmæ,* and *marginata.*

He does not specify localities, and thus leaves the botanical reader to infer that all these statements are of equal geological weight, which is far from being the case. In fact, for reasons already given and many others, a large part of the whole argu-

ment from geology is erroneous. Let us look closely for a moment at the real geological and geographical distribution of the fossil species of Platanus, especially the American species.

P. primæva Lx., is correctly referred to the Cretaceous, as it occurs only in the Dakota group of the United States.

P. primæva heerii Jankó (*P. heerii* Lx.) is also primarily a Dakota group species, but occurs in the Mill Creek series of Canada and in the Atane beds of Greenland, both of which are considered equivalent to the Cenomanian of Europe, and therefore not greatly different in age from the Dakota group. But I found a form at Black Buttes in the typical Laramie which I referred to that species, admitting some differences. Professor Lesquereux, who was very tenacious of his views as to the Tertiary age of the Laramie, challenged, in a letter, my determination, and I am not quite certain that it is correct. It may be as near to another Cretaceous species, *P. newberryana*, but it is not near to any Tertiary species. But *P. heerii* is not confined to the Cretaceous and Laramie if Gardner is right in reporting it from the Island of Mull at Ardtun, the Eocene age of that celebrated deposit being well established. On this point, however, there are doubts, as he only provisionally identifies the *Platanites* of Forbes with that species.

P. newberryana Heer, the other Cretaceous species, is, like the rest, a typical Dakota group form, and has not been found outside the Cretaceous, nor, indeed, outside the Dakota group, except in the Patoot beds of Greenland, which, however, are considerably higher in the series, being referred by Heer to the Senonian.

So much for the Cretaceous species. Next as to the alleged Eocene ones.

P. rhomboidea Lx. is only known in two specimens from Golden, Colorado. An examination of the specimens themselves shows that they are from the so-called tufa beds of South Table Mountain, and therefore belong to the Denver formation of Emmons, which he places somewhat higher than the Laramie. It may therefore pass as Eocene.

P. raynoldsii Newberry was originally described from the Fort Union group on the Missouri and Yellowstone Rivers, and I

found it in the Yellowstone Valley in 1883. The Canadian geologists report it from numerous points in what they call Laramie in the Northwest Territory, which I believe to be nearly or quite the same as the Fort Union group. As Dr. Newberry is not willing to admit the Laramie age of this group, and inclines to regard it as Tertiary, this may also pass as an Eocene species. It is not, however, strictly confined to the Eocene, for it has recently been found in a collection from the John Day River, Oregon, a Tertiary deposit that is generally placed near the top of that system as Pliocene or extreme upper Miocene. On the other hand, the variety *integrifolia* Lx. is a Laramie form from Black Buttes and Golden, and is therefore Cretaceous.

P. haydenii Newberry has very much the same range as the last, chiefly Fort Union group and Canadian Laramie, but it has not been found higher, and has been reported from certain doubtful deposits, such as Carbon, Medicine Bow, and Washakie, in Wyoming. It also occurs at Golden, and is said to be found in the typical Laramie of the Raton Mountains.

P. gulielmæ Göpp. is a well-known and widely distributed species of the European Miocene, also abundant in all the Arctic Tertiaries. Nathorst finds it in the Upper Tertiary of Japan, and it is by no means rare in the American deposits, being reported from Carbon, Washakie, Separation, Medicine Bow, Junction Station, etc., in Wyoming, perhaps Lower Tertiary; from Golden, probably Denver formation; and with less certainty from Black Buttes and the Raton Mountains, true Laramie. I collected it on the Lower Yellowstone, Fort Union group, and Lesquereux identified it in a collection from Mansfield, Louisiana (Mississippi Tertiary). It therefore appears to originate in the Upper Cretaceous.

Finally the Miocene and Pliocene species are:

P. aceroides (Göpp.) Heer. This is the most abundant of all fossil planes, and, accepting Professor Jankó's synonymy, is extremely variable. It is doubtless the immediate ancestor of all the living species, but it is not an exclusively Miocene and Pliocene species, as it occurs abundantly throughout the Arctic

Tertiaries, and in the Fort Union group and other deposits in the United States that are below the Green River group, and have been sometimes regarded as Laramie. If Tertiary at all, they belong at the very base of that series. Specimens have even been collected in the Bozeman coal mines, which Dr. Peale, who has devoted many years to their study, regards as Cretaceous. In the form of *Acer trilobatum*, which Lesquereux did not consider a Platanus, it also occurs in the Green River group on Troublesome Creek, Colorado, generally regarded as Eocene. It, therefore, doubtless also had its origin in the Cretaceous of America.

P. aceroides academiæ Jankó (*P. academiæ* Gaudin) is only known from the Upper Miocene deposit of Montemasso, Italy, and has no importance.

P. aceroides dissecta Jankó, including *P. dissecta* Lx., and *P. appendiculata* Lx., is confined, so far as now known, to the Upper Tertiary (Pliocene or Quaternary) of California (Chalk Bluff, Corral Hollow, Spanish Peak, Toulumne and Nevada Counties). The latter form, as I have shown, approaches very closely the American sycamore, *P. occidentalis*, and connects it by its basilar appendage with *P. basilobata* of the Fort Union group.

P. marginata (Lx.) Heer (*Viburnum marginatum* Lx.), the last species to be considered, is primarily a typical Laramie (Bitter Creek) species, but also occurs in the Denver formation at Golden, Colorado. Like so many other Laramie species, it is found in the Tertiary deposits of Greenland, where Heer first discovered its platanoid character. It is, therefore, not a Miocene species at all, but a Cretaceous species extending into the Eocene.

This hasty review enables us to revise the geological distribution of the fossil species of Platanus given by Professor Jankó, which should therefore stand as follows:

I. Exclusively Cretaceous species.—*P. newberryana* and *primæva.*

II. Species originating in the Cretaceous, but extending into the Tertiary.—*P. primæva heeri, marginatum,* and *raynoldsii integrifolium.*

III. Species originating in the Eocene.—*P. aceroides, gulielmæ, haydenii, raynoldsii,* and *rhomboidea.*

IV. Species not occurring below the Miocene.—*P. aceroides academiæ* and *aceroides dissecta.*

It will be observed that in the above distribution I have not considered the Fort Union group, the Denver formation, nor any of the deposits along the Union Pacific Railroad, except those on Bitter Creek, to be Cretaceous. I have also excluded the Bozeman coal mines containing *P. aceroides.* The radical difference between this distribution and that of Professor Jankó renders needless any discussion of his argument from geological considerations; and although I believe an argument can be based on these considerations, it would require to take into the account the more abnormal and archaic forms which he excludes from the genus. This argument is already stated in my previous papers, and the present one has become too long to admit of its expansion here.

EXPLANATION OF PLATE XXVIII.

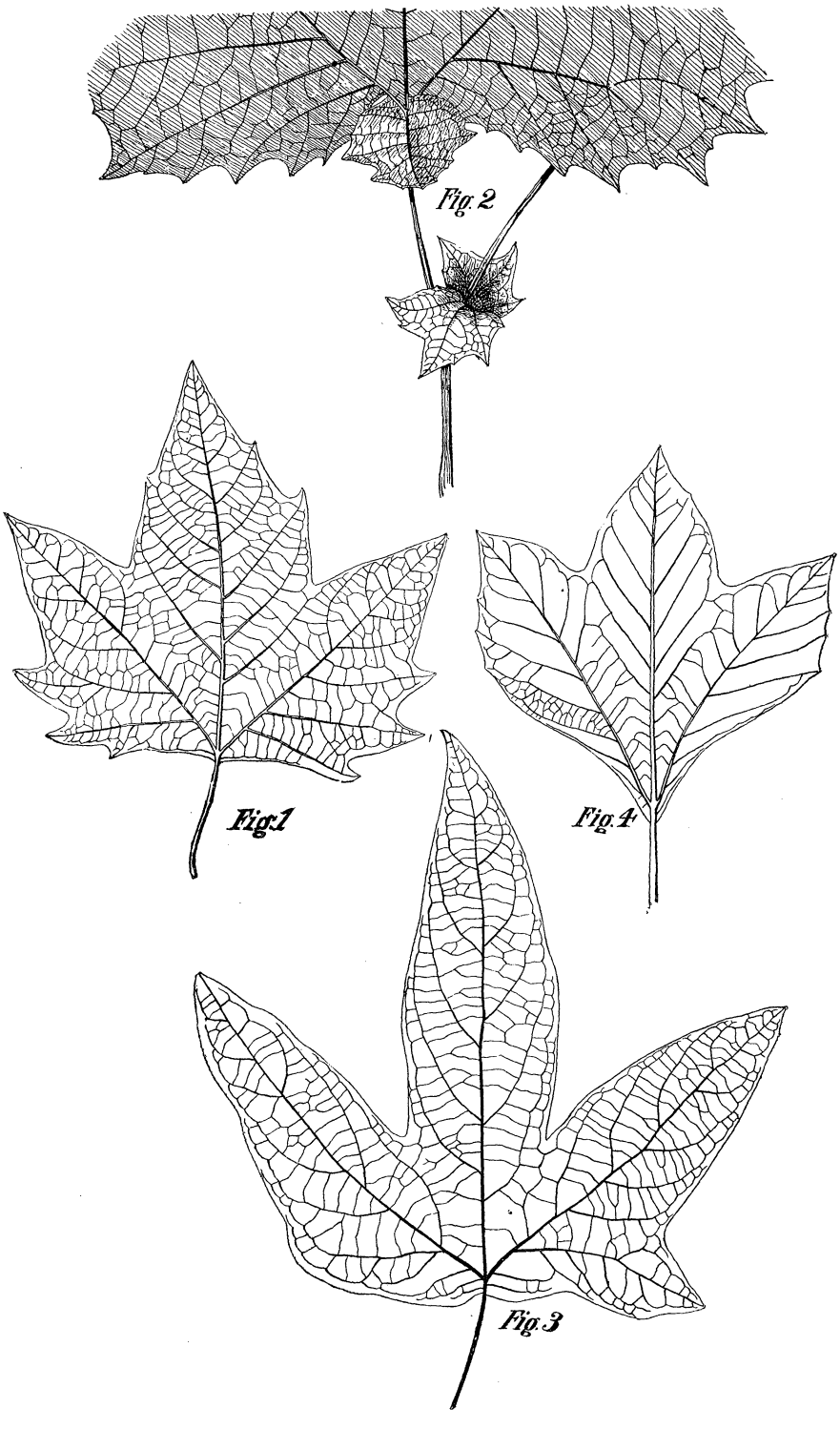
FIG. 1.—Leaf of *Platanus orientalis* L., from Washington, D.C. (cult.).

FIG. 2.—Lower portion of a leaf of *Platanus occidentalis* L., showing basilar and stipular appendages, from the District of Columbia.

FIG. 3.—Leaf of *Platanus racemosa* Nutt., from California, collected by Mrs. Austin.

FIG. 4.—*Sassafras cretaceum* Newb., Lesquereux, Cretaceous Flora, Pl. XI., Fig. 1. Dakota group.

PLATE XXVIII.



Platanus species.